ES-116 Project Report

Automatic Watering System

***Abstract*—This report presents the design and implementation of an automatic watering system using Arduino and a soil moisture sensor. The system aims to automate the process of watering plants by sensing the soil's moisture level and watering the plants accordingly. The system uses an Arduino microcontroller and a soil moisture sensor to monitor the soil's moisture level. When the moisture level falls below a certain threshold, the system activates a water pump to irrigate the plants. The system is cost-effective and can be used in various agriculture, gardening, and hydroponics applications.**

I. Aim

This project aims to develop an automatic watering system using Arduino and soil moisture sensors. The system is designed to provide an efficient and effective solution for plant care by automating the watering process.

The traditional method of watering plants involves manually monitoring the soil moisture levels and watering the plants accordingly. This method is time-consuming and labor-intensive and can often result in over- or under-watering, harming plant health.

II. Introduction

The traditional method of watering plants involves manually monitoring the soil moisture levels and watering the plants accordingly. Watering plants manually can be tedious and time taking and can often result in over- or under-watering, harming plant health. Automating the watering process can save time and ensure that plants receive the appropriate amount of water. The automatic watering system presented in this report is designed to simplify the process of watering plants by monitoring the soil's moisture level and watering the plants accordingly.

The system comprises an Arduino microcontroller, a soil moisture sensor, a water pump, and a power supply. The soil moisture sensor is used to measure the soil's moisture level, and the Arduino microcontroller is used to control the water pump based on the sensor readings. A 12V DC power supply powers the system.

III. Components Used

1. Arduino Uno
2. Soil moisture sensor
3. A 5V relay module
4. 12V DC mini water pump
5. 12V DC power supply
6. Bread Board
7. Jumper wires

IV. Theory

- Soil moisture sensor

The Soil moisture sensors are devices that measure the amount of moisture present in the soil. These sensors work by measuring the soil's electrical conductivity or dielectric constant, which is directly related to the amount of water present.

Different types of soil moisture sensors are available, including resistive, capacitive, and time domain reflectometry (TDR) sensors. Resistive sensors measure the resistance of the soil, which decreases as the moisture content increases. Capacitive sensors measure the dielectric constant of the soil, which increases as the moisture content increases. TDR sensors measure the time it takes for a pulse of electromagnetic energy to travel through the soil, which is related to the soil's moisture content.

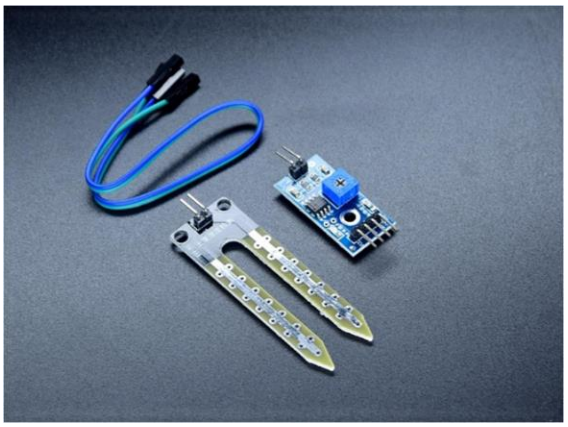


Fig. 1. Soil moisture sensor

V. Working

The system is designed to work as follows:

1. The soil moisture sensor is connected to the Arduino microcontroller board, which receives the sensor data and uses it to the water pump.
2. A relay module connects the water pump to the Arduino board.
3. The Arduino board is programmed to read the soil's moisture level from the sensor.
4. If the moisture level falls below a certain threshold, the Arduino board activates the relay module to turn on the water pump.
5. The water pump then irrigates the plants until the soil's moisture level reaches the desired level.
6. The process is repeated at regular intervals to ensure that plants receive adequate water.

VI. Circuit Diagram and procedure

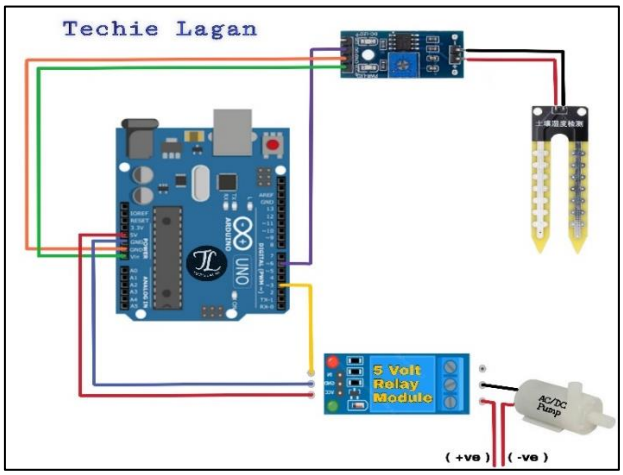


Fig. 2. Circuit Diagram of the automatic watering system

- Power the soil moisture sensor with the help of Arduino's 5V power pin.
- Take the input in the Arduino from soil moisture at digital PWM pin 6 of Arduino.
- Now power the relay module from the input side with the help of Arduino.
- Connect the positive terminal of the water pump to the common mode pin of relay module.
- Now connect the IN pin i.e. input pint of the relay module to the digital PWM pin 3 of Arduino to control the water pump.

NOTE: *The external power can be replaced by a 12V adapter connected directly to the Arduino board.*

VII. Programming Logic

The soil moisture sensor is connected to one of the digital input pins on the Arduino Uno board. The output of the sensor is a voltage that is proportional to the moisture level in the soil. The Arduino Uno board then reads this voltage and compares it to a pre-set threshold value. If the moisture level falls below the threshold value, the Arduino Uno board triggers the relay module, which turns on the water pump. The pump then pumps water from the container through the plastic tubing to the plants until the moisture level in the soil reaches the desired level. Once the moisture level is restored, the relay module turns off the water pump, resetting the system.

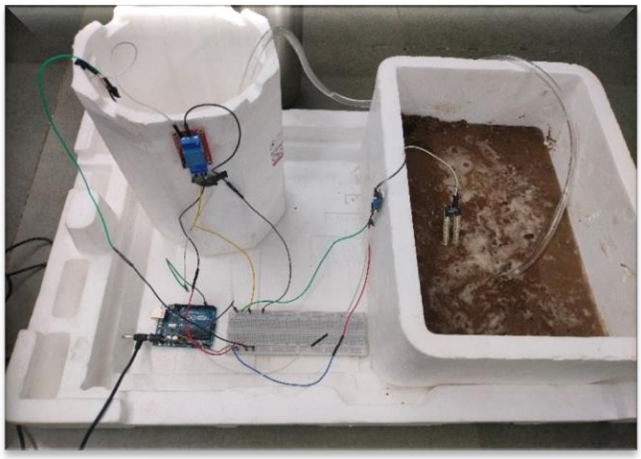
VIII. Experimental data

Soil moisture Level	Output on serial monitor
Very high	300-500
Intermediate	700-800
Very Low	900-1023

TABLE I. Experimaental data from the soil moisture sensor

The input from the soil moisture sensor is a voltage that is inversely proportional to the moisture level of the soil. For this project we have used 700 as a threshold input voltage. If the input goes above 700, it means the moisture level is very low and therefore the Arduino will turn on the water pump. When the moisture level goes below 700, the Arduino will send a signal to relay module and the water pump will be turned off. We can customize the threshold value as per the requirement of the plant.

IX. Experimental setup



X. Results of the experiment

The automatic watering system was successfully implemented and tested. The system was able to monitor the moisture level of the soil and water the plants when the moisture level fell below the threshold. The system was able to irrigate the plants at regular intervals and ensure that they received adequate water.

XI. Usability

The automatic watering system is designed to be easy to use and can be customized to suit different plant types and environments. Farmers can use the system to manage large-scale crop production. The system can be customized to suit different crops and soil types, ensuring optimal moisture levels for healthy growth. Farmers can customize the automatic watering system to suit their specific crop types and growing conditions. For example, different crops require different moisture levels, and the system can be calibrated to provide the appropriate amount of water. Additionally, different soil types may require different watering schedules, which can be adjusted to suit the specific needs of the crops.

Moreover, the automatic watering system can be used in a wide range of settings, from indoor home gardens to large-scale outdoor agriculture. The system is adaptable and can be modified to suit different plant types and growing conditions. The system's flexibility makes it a versatile and valuable tool for plant care.

XII. Future Developments

The current system can be further improved and expanded in several ways. Some future developments for the system include:

1. Integration with weather sensors: The system can be enhanced by incorporating weather sensors to adjust

the watering schedule based on environmental factors. For example, temperature and humidity sensors can be used to monitor environmental conditions and adjust the watering schedule accordingly. Light sensors can also be used to ensure that the plants are receiving the appropriate amount of light.

2. Wireless connectivity: The system can be made wireless, allowing users to remotely monitor and control the system using their smartphones or other devices.
3. Automated nutrient delivery: The system can be expanded to include a computerized nutrient delivery system, providing plants with essential nutrients for healthy growth.

XIII. Conclusion

The automatic watering system using Arduino and soil moisture sensors is a promising technology for efficient and effective plant care. The system provides the appropriate amount of water to the plants, eliminating the need for manual watering and saving time and effort for the user. The system is highly customizable and can be modified to suit different plant types and growing conditions. The system can be integrated with other agricultural technologies to create a comprehensive solution for crop management. The automatic watering system is a valuable tool for plant care that can optimize crop production and improve plant health.

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